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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. DP-310764

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ACHIM ROSEMANN  
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**COVER SHEET FOR FILING PROVISIONAL APPLICATION**  
**37 CFR 1.53 (c)**

Mail Stop Provisional Patent Application  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

This is in request for filing a PROVISIONAL APPLICATION FOR PATENT  
under 37 CFR 1.53 (c).

1. The following comprises the information required by 37 CFR 1.51 (c)

2. The name of the inventors are:

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4. The title of the invention is:  
  
BATTERY DISCONNECT DEVICE
  
5. The name, registration and telephone of the attorney is:  
  
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Docket No. DP-310764
  
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Attorney Docket No. DP-310764--3

8. This invention was not made by an agency of the United States Government, or under contract with an agency of the United States Government.

9. Identification of documents accompanying this cover sheet:

A. Documents required by 37 CFR 1.51(c)(2) and 37 CFR

1.51(c)(3):

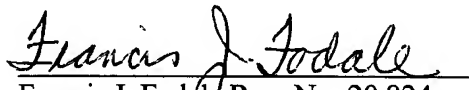
Specification:	No. of Pages: 10
Claims:	No. of Claims: 6
Drawings:	No. of Sheets: 7

10. Fee: the filing fee for this provisional application, as set in 37 CFR 1.16(k), is \$160.00 for other than small entity.

11. Please charge the \$160.00 filing fee to DELPHI TECHNOLOGIES INC. Deposit Account No. 50-0831. Please charge Deposit Account No. 50-0831 for any fee deficiency.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as express mail with the label number as EV 331393583 US addressed to the Mail Stop Provisional Patent Application, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450, on August 8, 2003.

  
Noelle Constantinou

## BATTERY DISCONNECT DEVICE

### TECHNICAL FIELD

The present invention relates to an automotive battery disconnect device  
5 and more particularly to a device to protect a primary battery cable in the event  
of a short circuit.

### BACKGROUND OF THE INVENTION

Primary battery cables can be short circuited to ground in a severe vehicle  
10 collision. Devices currently exist to deal with this problem.

Figure 1 discloses a Pyrotechnic Battery Cable Disconnect device that is  
currently in production and is further described in US Patents 6,144,111 and  
6,171,121. When actuated by a remote signal, this device fires a pyrotechnic  
charge to dislodge the battery cable from a press fit in the terminal attaching it  
15 to the battery. This remote signal is most commonly provided by an airbag  
controller when a collision event is detected.

This design has significant disadvantages. The majority of collisions which  
deploy airbags do not result in short circuiting of battery cables, yet with this  
mechanism, the primary battery cable is disconnected in all collision sensed  
20 events. This disables the starting circuit and consequently requires either  
towing the vehicle or a jump start to move the vehicle, if the engine stalled or  
was turned OFF after the collision. Moreover, this design requires replacement  
of all or a portion of the battery cable in the vehicle to reconnect the starter  
circuit. This is a labor intensive and expensive service option.

A similar pyrotechnic circuit disconnect device is disclosed in US Patent 6,556,119 . This device provides means for cutting a bus bar in a manner which could control (or slow down) the speed of current interruption in the circuit. The stated purpose of this device is to limit the inductive voltage peak which results from a rapid change in current, as caused by similar pyrotechnic disconnects. This device presumes that the disclosed disconnect device is initiated in response to a short circuit and then eliminates the over current condition in a controlled manner. As such, this design suffers from the shortcomings of similarly proposed devices described below.

10

Figure 2 discloses a Pyrotechnic Disconnect with a Current Sensor that is shown in EP0725412 and which describes the concept of using electronics to detect when a current threshold has been exceeded, rather than preemptively disconnecting on airbag deployment. Any condition which results in exceeding a specified over-current threshold on the battery cable (with current amplitude and time duration limits) causes the disconnect to be actuated. A similar concept is described in US patent 5,783,987.

15

This design also has significant disadvantages. A 'blocking' signal is required to inhibit the electronics during normal engine cranking since crank currents typically exceed desired over-current thresholds. A blocking signal is also required for a jump start (J/S). Failure of the blocking signal would likely result in tripping the over-current threshold on the next engine crank or jump start attempt, resulting in a nuisance actuation of the disconnect and a potential walk-home condition. Moreover, the electronic current detection required to

20

accomplish this functionality adds additional failure modes that lower the reliability of the design and add cost.

Figure 3 discloses a Forced Fusion Fuse device that is shown in US Patent  
5 6,243,245 describing a circuit protection device that combines the functionality  
of a fuse element with the ability to 'force' the fuse to open. The 'forced open'  
function is accomplished by applying current on a separate circuit, which  
initiates a thermal reaction and melts the fuse element, irregardless of load  
circuit current. In this concept, the fuse is a series element that must conduct all  
10 load current carried by the device. Significant disadvantages of this device  
include the same disadvantages described above in connection with figure 1 if  
the device is actuated preemptively on airbag deployment. On the other hand, if  
the device is combined with electronics and then actuated upon detection of an  
over-current, the device has the disadvantages described above in connection  
15 with figure 2.

US patent application 10/230837 filed August 29, 2002 and assigned to the  
assignee of the present invention discloses a battery circuit disconnect that  
comprises an indented electrical conductor and a separator mechanism using  
kinetic energy.

20

#### SUMMARY OF THE INVENTION

The invention provides a battery disconnect device in which a disconnect  
element and a fuse element are parallel electrically.



## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side partially section view and three photographs of a prior  
5 art pyrotechnic battery cable disconnect;

Figure 2 is a sectioned view of another prior art pyrotechnic disconnect  
device with a sensor;

10 Figure 3 is a plan view of still another prior art disconnect device, the  
device having a forced-fusion fuse;

Figure 4 is a schematic view of a battery disconnect device of the  
invention;

15 Figure 5 is a plan view of another battery disconnect device of the  
invention;

Figure 6 is a schematic view of still another battery disconnect device of the  
20 invention; and

Figure 7 is a schematic view of still yet other batter disconnect devices of  
the invention.

## 25 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring now to figure 4 of the drawings, a battery disconnect device (10)  
of the invention is connected in series in the primary circuit between the

positive post of a battery (12) and some typical vehicle electrical loads, such as a Starter S, a Generator G and an Under Hood Electrical Center U/H BEC. The battery disconnect device (10) includes a disconnect element (13) and a fuse element (14) configured electrically in parallel as shown. Additionally, the battery disconnect device (10) interfaces to an external controlling module (15) via one or more signal wires. Disconnect element (13) and fuse element (14) are preferably disposed in an appropriate housing (16).

When connected in series as part of an automotive battery circuit, battery disconnect device (10) operates as follows. Load current is conducted between points (21) and (22) via the disconnect element (13) and parallel fuse element (14). The disconnect element (13) is designed with appropriate material, cross-section and length to carry the majority of electrical current required by the vehicle loads, and in all cases insures that the fuse element (14) does not conduct enough current to melt or open under normal use. The disconnect device (10) further includes means to open or break the current path through the disconnect element (13) when signaled by an external control module (15). Any appropriate means to open or break the current path may be used including a pyrotechnic disconnect that is detonated, a switch contact that is opened or a fuse element that is melted. Battery disconnect device (10) also includes appropriate interconnects and sub-components necessary to control the disconnect element (13) when signaled by the external controlling module (15) via the signal wire or wires.

In the event of a vehicle collision (perhaps of sufficient force to cause the airbags to deploy), the battery disconnect device (10) is preferably signaled to actuate and open the current path through the disconnect element (13) before a collision induced short circuit of the protected battery cable might occur. If a battery cable short circuit does occur subsequently, the fuse element (14) opens the remaining parallel circuit and eliminates the short. In this case, the protected battery circuit is permanently disconnected from the battery positive post with no means of resetting or closing the circuit (since doing so could cause an electrical / thermal event). On the other hand, if a battery cable short circuit does not occur in the collision event, the fuse element (14) does not open the parallel circuit. The fuse element (14) is designed to enable re-starting the vehicle engine, in the event that the engine stalled as a result of the collision or the engine is turned OFF after the collision. In this second case, the fuse size or rating required to re-start a warm engine after a collision (presuming the engine was running before the collision) can be significantly less than the size or rating of a fuse that is disposed in the starter circuit throughout the life of the vehicle which must accommodate a cold start. The fuse element (14) with a smaller fuse rating still provides a significantly improved circuit protection of the primary battery cable(s) during a collision as well as an engine re-start capability after a collision if a short circuit of the battery cable(s) does not occur.

In either of the above cases (with or without a collision induced electrical short circuit on the battery cable), the battery disconnect device (10) is

ultimately removed and replaced as part of the vehicle service repairs performed after a collision. These repairs include inspecting the protected battery cable(s) for damage due to the collision with repair and/or replacement of the battery cable(s) as required prior to returning the vehicle to normal use.

5

Referring now to figure 5, an alternative for the disconnect and fuse elements (13 and 14) in parallel is disclosed. In this embodiment of the battery disconnect device shown generally at (110), the disconnect and fuse elements are a single stamping (111) with holes (121 and 122) for bolting the stamping (110) onto studs (not shown) for connection to the load circuit connection points shown at (21) and (22) in figure 4. The disconnect element of stamping (111) is a generally rectangular bus bar (113) that is notched or otherwise weakened to provide a narrow juncture (114), thus providing for ease of disconnect via a pyrotechnic component (not shown). The fuse element of stamping (111) is provided by smaller bus bar (115) that is a parallel electrical path for carrying current between end portions of the larger bus bar (113) on opposite sides of juncture (114) that have holes (121) and (122) respectively for fastening stamping (111) to the connection points (21) and (22) shown in figure 4. The smaller bus bar (115) contains a fuse element (116). The operation of the battery disconnect device (110) comprising the stamping (111) operates in the same was as the battery disconnect device (10) described above. Further as demonstrated by the battery disconnect device (10), it is possible to use a disconnect element and a separate fuse element connected electrically in parallel with the disconnect element, without integrating the fuse and disconnect

elements in a single bus bar. Any of these, and other embodiments could readily be disposed in a housing along with a battery terminal clamp or other connections to assemble this device in an automotive circuit (as shown in figure 4) easily, and provide for inexpensive service replacement.

5       The battery disconnect devices (10) and (110) of the invention described above enable vehicle operators to re-start the engine and potentially drive the vehicle after a collision (if not disabled by other damage) to avoid a secondary collision or multiple vehicle pile-up, to obtain medical treatment and/or to minimize towing or other roadside assistance costs and time delays.

10

      The battery disconnect devices (10) and (110) of the invention described above provide for easy service replacement of the disconnect device, using a bolted connection as shown in one of the embodiments.

15       The battery disconnect devices (10 and 110) of the invention do not require a 'blocking signal' to inhibit electronic current detection means during normal engine cranking or jump start procedures.

      The battery disconnect devices (10 and 110) of the invention do not rely on  
20       electronic current detection and are inherently more reliable means of providing the needed collision related circuit protection.

      Figures 6 and 7 show other embodiments of the invention that are also described in connection with the respective figures. Briefly, the disconnect

element shown in figure 6 is a switch while in figure 7, the disconnect element is a pyrotechnic disconnect or a bus bar that includes a smaller bus bar fuse element.

5           Several additional modifications of this invention would be obvious to those skilled in the art and may include various methods of making the load circuit connections (other than bolts/studs/clamps), various configurations of bus bars or other electrical conductors that could be readily manufactured to carry the load current and form the parallel arrangement of a disconnect element  
10       and a fuse element; and various types of disconnect elements (as described above) and fuse elements that could be configured as disclosed here to accomplish the described automotive battery disconnect functionality.

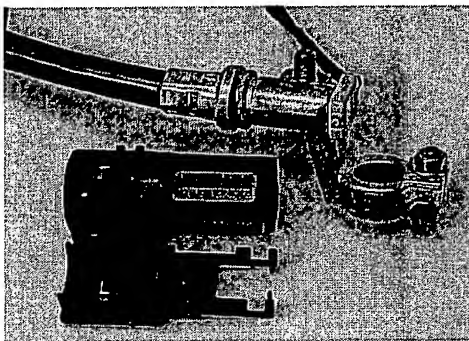
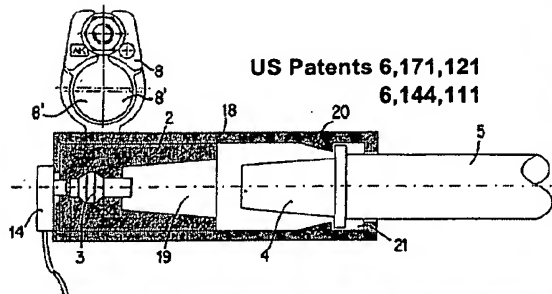
          In other words, although preferred embodiments of the invention have been disclosed in detail, various changes and modifications may be made to the  
15       preferred embodiments by one skilled in the art without departing from the spirit and scope of the invention as set forth in the appended claims.

## CLAIMS

We claim:

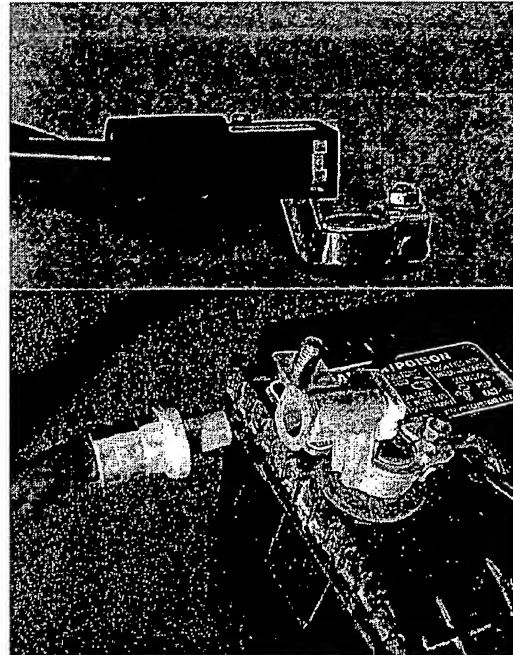
1. A battery disconnect device comprising a disconnect element and a fuse element in parallel with the disconnect element.
- 5 2. The battery disconnect device of claim 1 wherein the battery disconnect element further comprising means to open the current path through the disconnect element while the current path through the fuse element remains in tact.
- 10 3. The battery disconnect device of claim 1 or claim 2 wherein the disconnect element has a higher current capacity than the current capacity of the fuse element .
- 15 4. The battery disconnect device of claim 3 wherein the disconnect element and the fuse element are a single stamping.
5. The battery disconnect device of claim 3 wherein the disconnect element is opened pyrotechnically.
- 20 6. The battery disconnect device of claim 4 wherein the disconnect element is opened pyrotechnically.

Prior Art:  
Pyrotechnic Battery Cable Disconnect



*DP-310764*

Delphi Technologies, Inc., Troy, MI



**Figure 1**



Prior Art:  
Current Pyrotechnic Disconnect with a Sensor

EP 0725412

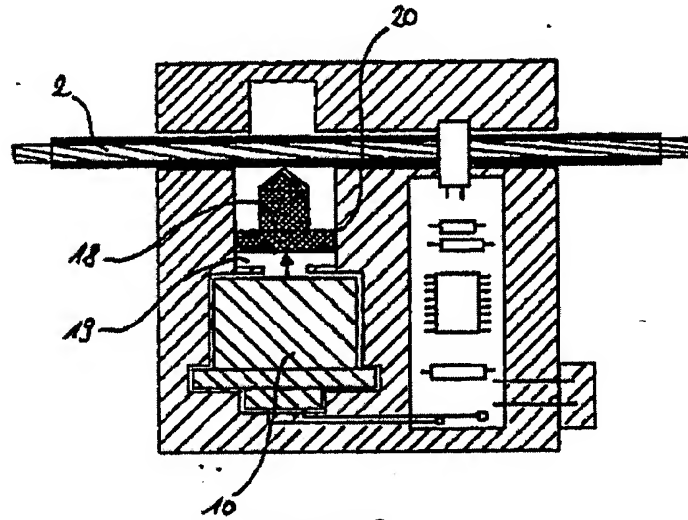


Figure 2

DP-310764

Delphi Technologies, Inc., Troy, MI

## Prior Art: Forced-Fusion Fuse

US Patent 6,243,245

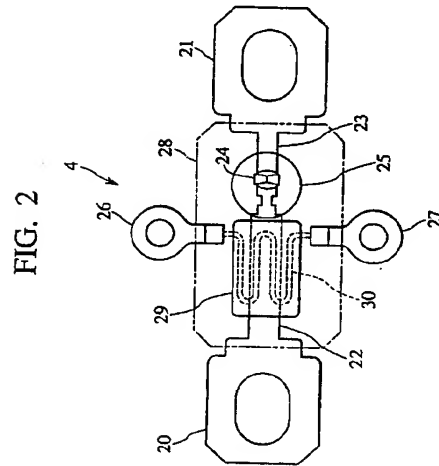
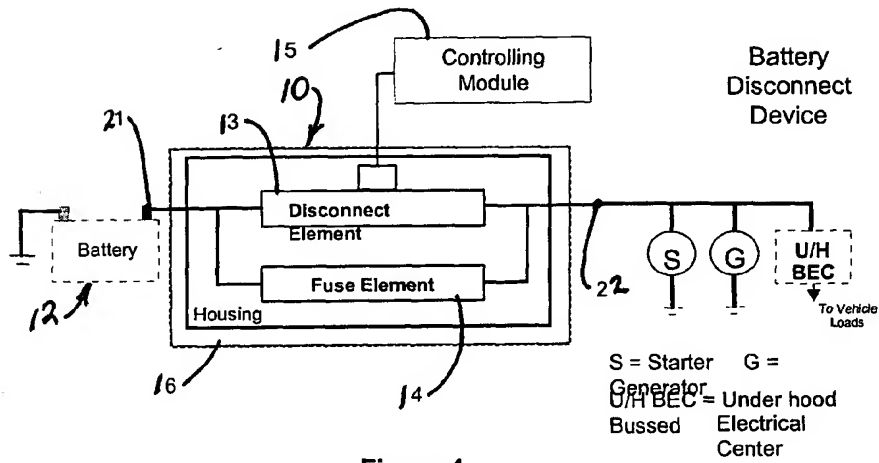


Figure 3

# Invention: Low Cost Battery Disconnect Device



DP-310764

Delphi Technologies, Inc., Troy, MI

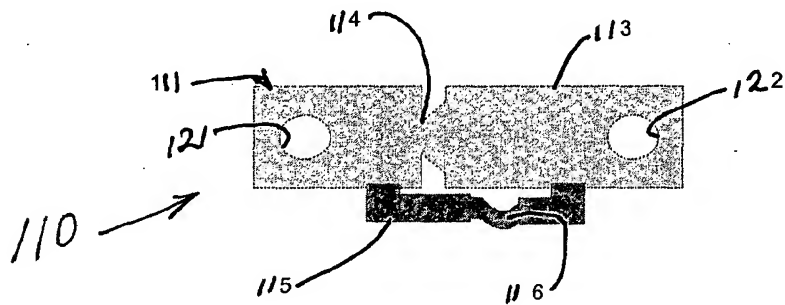
## Low Cost Battery Disconnect Device

### Possible Embodiment

The disconnect element and fuse element are a single stamping

The disconnect element is a notched bus bar

The notched bar is sheared by a pyrotechnic charge and cutter (not shown)



**Figure 5**

*DP-310764*

Delphi Technologies, Inc., Troy, MI

Battery Disconnect Solution  
using a Normally Open Switch

and capable of short circuit protecting  
battery circuit with ALL vehicle  
loads on a single battery cable.

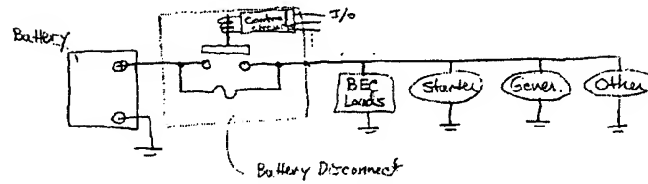


Figure 6

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Delphi Technologies, Inc., Troy, MI

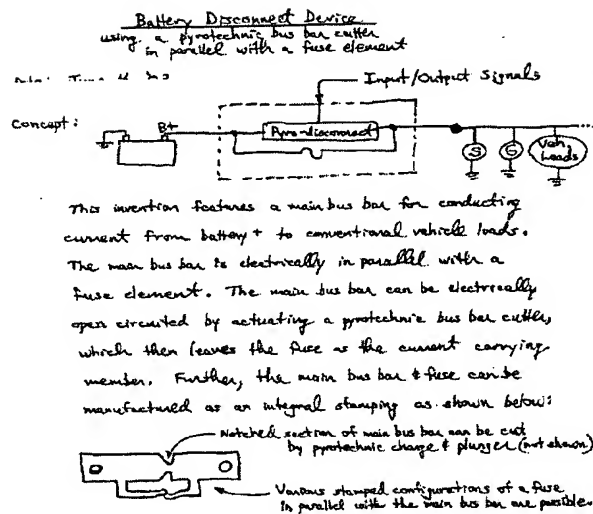


Figure 7

DP-310764

Delphi Technologies, Inc., Troy, MI